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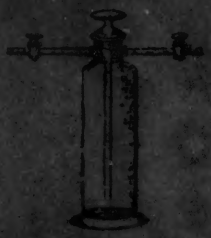

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THE APPLE BLOTCH AND BITTER-ROT CANKERS

JOHN W. ROBERTS

The apple blotch canker caused by *Phyllosticta solitaria* E. and E. and the apple bitter-rot canker caused by *Glomerella cingulata* (Stoneman) Spaulding and von Schrenk have been discussed by various writers, but chiefly as sources of infection in connection with the diseases on the fruit.[1] The present paper is a discussion of the cankers as such, with little regard to their importance as infection sources.

THE APPLE BLOTCH CANKER

As affecting the life of the tree, the blotch canker is not, as a general thing, entitled to very serious consideration. The lesions are small and persist for a relatively short time. They are not sufficiently numerous to cause much damage in the commercial orchard which receives several sprayings each year. In poorly cared-for orchards, especially in the southern portion of the Middle West, many twigs may be severely injured and even killed. In the case of such susceptible varieties as Northwestern Greening and Missouri Pippin, the trees themselves may become so thoroughly infested over a term of years that eventually they are killed.

The blotch canker first appears as a raised, black, blister-like spot on a twig or water-sprout of the current year's growth. It may become slightly sunken with the approach of autumn, but usually it continues somewhat raised above or level with the adjacent healthy tissues until the following summer and often throughout its life. As the twig or water-sprout matures the canker becomes lighter colored, and finally, in its second year, assumes a light tan color in the older or central portion with a dark border denoting the extent of the second year's growth.

[1] For references to the literature dealing with these cankers see: Roberts, John W. Apple blotch and its control. U. S. Dept. of Agr. Bul. 543, 1917. The sources of apple bitter-rot infections. U. S. Dept. of Agr. Bul. 684, 1918

Infection can take place only on the young branches of the current year's growth. Vigorously growing water-sprouts are especially susceptible. The writer has at different times attempted to inoculate older twigs, both by spraying them with water containing spores and by inserting spores beneath the bark. In no case have infections followed these attempts. On the other hand, the young green twigs of the current year when sprayed with water containing spores have invariably become infected. Inoculations through slits have been unsuccessful even in these twigs. The manner of infection has not been determined. It may be that the germ tube is able to penetrate the young and tender epidermis of the presence of stomata may be necessary for infection.

Though the spores germinate readily, subsequent development is very slow, six to eight weeks elapsing after inoculation before the cankers become visible. During the year in which infection takes place and during the earlier part of the following year, *Phyllosticta solitaria* is apparently actively parasitic. It increases the size of the infected area, and most of the cankers are free from other fungi. After this time, however, the fungus makes little if any further growth. Other fungi invade the cankered area and form their fruits on its surface.

During its first year, the fungus appears to make some growth during the dormant season of the host. By the first of May in the Ozarks the canker has expanded considerably and the fungus soon reaches the limit of its development.

Toward the end of the second season and especially in subsequent seasons one is apt to find the fruiting bodies of species of *Phoma* or other fungi abundant in the old canker, with a paucity or more often an entire lack of the pycnidia and spores of *Phyllosticta solitaria*. Apparently the tissues of the host have changed so that they are able to resist further invasion by the last named fungus. It is possible that the fungus is no longer able to absorb the necessary food materials, either because of the thickened walls of the host cells or because of the osmotic pressure changes within them. It is probable, moreover, that the more firmly compressed tissues of the host prevent or check the further intercellular development of the fungus. The hyphae, very slow growing even under the most favorable conditions, then would be cut off from proximity to young, thin-walled cells, which alone they seem able to parasitize. Under such conditions one would expect, as indeed does occur, the copious formation of fruiting bodies eventually followed by death. The hyphae are of comparatively large diameter and grow quite slowly, even in the tissues of very young twigs. A check in growth might easily cause their death by leaving them remote from the supply of nutrient materials.

Late in September, 1918, Ben Davis twigs of the current year infected with blotch were removed from the tree and used as material for sections. Appropriate lengths of these twigs were fixed in a mixture of picric acid, mercuric chloride and alcohol and demineralized in hydrofluoric acid. They were then dehydrated, embedded in celloidon, sectioned and stained. The most satisfactory stain used was the Pianeze IIIb as recommended by Vaughan.[2] This stain gave excellent differentiation and was in every way very satisfactory.

The hyphae within the tissues of the host are intercellular and of rather large diameter in proportion to their length. The tips are broad and blunt, often being broader than the main portion of the hyphal thread.

The infected cells are those of the cortical parenchyma, and the cambium. It is apparent therefore, that only thin-walled, not fully differentiated parenchymatous or meristematic tissues are invaded. The cells in the diseased area are filled with gum and are for this reason easily distinguished from cells remote from the infected area. Since only tissues composed of young, thin-walled cells are affected, the reason why only the young green growth of the current year is susceptible becomes apparent.

Pycnidia containing spores were found in the sections, some of them being located so far beneath the epidermis and so deeply embedded in the host tissues as to suggest that they may be blind pycnidia, *i.e.*, pycnidia which would not reach and rupture the epidermis.

In orchards that are regularly sprayed for the prevention of blotch infections on the fruit, the cankers gradually decrease in number until the trees are nearly free from them. The spraying prevents the formation of new ones, and the older ones, in which the fungus soon dies, heal over.

By coating the young twigs with the spray, infection by the fungus is largely prevented and hence few new cankers can be formed. Also, spraying, by preventing infections on the fruit, lessens in number the sources from which could arise spores capable of bringing about twig infections.

THE APPLE BITTER-ROT CANKER

The direct damage to the tree by this canker is usually slight except in the case of unusually susceptible varieties, but beside its importance in connection with bitter-rot of the fruit, its non-occurrence in certain sections in which bitter-rot is prevalent and its peculiar host relations make it of interest to plant pathologists. The writer has discussed these phases of the subject somewhat in detail in a previous paper.[3]

[2] Vaughan, R. E. A method for the differential staining of fungous and host cells. Annals Mo. Bot. Gard. **1**: 241–242. 1914.

[3] Roberts, John W. The sources of apple bitter-rot infections. U. S. Dept. Agr. Bul. 684, 1918.

The canker begins by lodgment of the spores of the fungus in a wound or in a dead area. If conditions are favorable, *i.e.*, if moisture is present and the temperature is high, germination and subsequent infection take place very rapidly. When inoculations are made in mid-summer the canker becomes evident in a week or less. About the inoculated point, a rim of blackened bark appears, which may within a month attain a width of 50 mm. As the weather becomes cooler, growth ceases. In one series of inoculations there was no further growth after the first of August, the temperature being cool throughout the remainder of the season. Inoculations made in the autumn were unsuccessful.

As soon as increase in the size of the canker ceases, a layer of callus begins to form at the margins of the canker, which by mid-summer of the year following has rather well isolated the cankered portion of the bark. In this way the host usually prevents further growth of the canker, since the callous layer not only prevents spread of the initial canker but also effectively prevents the occurrence of new infections. The fungus lives and fruits in the isolated canker during the first and second years, but in the third year it was found to be dead and the lips of the callous layer nearly closed over the wound in nearly all the cankers artificially produced by the writer. In the case of especially susceptible varieties, such as Givens, the cankers may persist for many years. Givens does not start growth until very late in the season, often two weeks later than most varieties, and is peculiarly lacking in vigor. Cankers on the branches of Givens are often of large size and show the usual characteristics of the bitter-rot canker, *i.e.*, a blackened, depressed area with the bark clinging tenaciously to the wood. They also show concentric rings indicative of their age.

On June 28, one-year-old Ben Davis twigs were inoculated by introducing spores of the fungus into the bark through slits. By the first of August there was about the slit a blackened band 5 mm. wide, which after that time did not increase in size. By October the margin of the canker had begun to show slight rifts, indicating that the host had formed a callous layer about the dead area. On October 2, appropriate lengths of these cankered twigs were removed and after treatment with hydrofluoric acid and a mixture of glycerine and alcohol were sectioned without embedding. In all the sections the mycelium was found to be intercellular. In no case could a single filament be found within the cells. Hyphae were also found in the portions of the cankered bark which were adjacent to and sometimes clinging to the layer of callus, indicating that the growth of the fungus had kept pace with the death of the cells and that the cessation of development of the canker was not due to isolation of the fungus through the death of cells in advance of its growth. As before stated, cessation of growth was probably due to the lack of the high temperature necessary for the development of the fungus.

In the sections, even when viewed macroscopically, the most noticeable thing was the brown coloration of the diseased portion due to the formation of gum within the cells. In the cankered portion gum permeates the tissues at least as far as and often includes the pith. Even the cells of the outermost layer of the callus contain slight deposits of gum, which was probably formed originally within cells that by later division took part in the formation of callus. It is, of course, most abundant in the bark and cambium but it is also to be found in the wood and especially in the pith rays. So filled with gum are the last named that they appear as yellowish-brown bands running through the wood from pit to cambium. They are in sharp contrast with the bright, silvery wood, which is only flecked with the yellowish-brown gum, an effect due not to the absence of gum in the lumina but to the thickness of the cell walls and consequent relative smallness of the lumina. In the vessels the gum is bright yellow. It is doubtless the gum which causes the dead bark to adhere so tenaciously to the underlying tissues. The callus is the usual wound callus described by many investigators. It is composed of layers of thin-walled suberized cells and is able to isolate the canker, as the sections show, in a surprisingly short time. The number of layers composing the callus varies from six to twelve even in the same section.

A series of inoculation experiments made by the writer has indicated that there is considerable difference in the susceptibility of different varieties to infection. York Imperial proved to be practically immune while Yellow Newton was almost as resistant. Ben Davis, Jonathan, Missouri Pippin, Grimes Golden and Winesap were moderately susceptible but were not nearly so susceptible as Givens.

As before stated, bitter-rot cankers are usually rather short lived. Inoculation experiments show, however, that while the cankers on young, vigorous twigs or water-sprouts are usually healed over by the third year and are chiefly dangerous as infection sources during the second year, in the case of older, slow-growing branches there is not the same vigorous development of callus and the canker may therefore be relatively long-lived.

Bitter-rot cankers are most easily found during the dormant season when they are not concealed by foliage, or at the time when the first infections appear on the fruit. Cankers, when present, may often be found just above clumps of the earliest affected fruits. During and immediately after a series of years in which bitter-rot has been severe in orchards of the southern part of the Middle West, bitter-rot cankers are usually fairly abundant. Otherwise they are relatively scarce and hard to find. Usually the writer has found them most numerous on the variety Givens, but they are often abundant on Jonathan and Ben Davis.

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OBSERVATIONS ON THE DISTANCE OF SPREAD OF AECIOSPORES AND UREDINIOSPORES OF CRONARTIUM RIBICOLA

WALTER H. SNELL

As part of an intensive campaign to get definite data on several points in the life history of *Cronartium ribicola*, the writer undertook certain phases of the problem of the distance of spread of the aeciospores and urediniospores. The work was carried on under the general direction of Dr. Perley Spaulding, in charge of the scientific investigations on the white pine blister rust by the United States Department of Agriculture. The present paper deals with results obtained in the Adirondack Mountains, New York, in 1918, and near Rush Lake, Minnesota in 1919. These results were obtained by the employment of indirect methods. Spores were not caught in traps, but observations were made upon natural infections on pines and Ribes under the proper conditions. The investigations were undertaken with a view to obtaining data on the potential distance of spread of the spores. In the case of the aeciospores, some such evidence was obtained, but drought conditions prevailing at the time of the observations upon the urediniospores changed the aspect of the investigation from the potential distance of spread to that of behavior under dry conditions.

DISTANCE OF SPREAD OF AECIOSPORES

East of Rush Lake in Minnesota in the spring of 1919, an area favorable for making the desired observations was located. Rush Lake is crescent-shaped with its axis east and west and the horns of the crescent to the south. Within the semicircle to the south of the Lake is a large scattered pine infestation, and to the southeast and east of this lies an area of several sections almost devoid of pine. It is level country, mostly cultivated farm land and meadow, with some hardwood woodlot and pasture, and some hardwood and tamarack swamp. In this area there were many "centers" of infection with no pines within one-half to one mile. In one large portion of this area a Ribes center was found on June 12, one and one-quarter miles from any pine whatever. The first uredinia were located in that area on June 6, and inasmuch as twelve to fifteen days is the incubation period for the uredinia of *Cronartium ribicola* under the most favorable conditions, any uredinia found within ten days after the finding of the

first uredinia of the season were considered of the first generation. Daily search for uredinial infection was being made in this immediate vicinity by several scouts and there could, therefore, be no doubt but that the first uredinia were located about as soon as they appeared.

The inspection of the pines was done in the spring. In the fear that there might have been some more pines in the heavily leaved hardwoods or in the tamarack swamps then impenetrable because of abundance of water, another inspection of the area was made in November after the leaves were off the hardwoods and tamaracks, and when the swamps were frozen. Inspection made under these more favorable conditions revealed no pines within the radius of one and one-quarter miles. Hence, there is no doubt but that the aeciospores had to travel at least this one and one-quarter miles in order to infect this particular bush.

The weather conditions during the spring of 1919 near Rush Lake were very moist and hence very favorable for the spread of the rust, and prevailing westerly winds spread most of the infection east and southeast. The center used for distance determination was by no means the only one found. It was one of many infected bushes on the outer edge of the fan-shaped zone of infestation spreading to the east and southeast from the original pine center. At the distance of one to two miles, infected bushes could be quite readily found in the wood-lots. These facts are presented to show that the center chosen was not merely a single far-flown infection and therefore quite out of the ordinary, but was one of many in a zone more than a mile from the nearest pine and fully three miles from any pine at present known to be diseased. It is reasonable to assume that beyond this zone in which many infected bushes were found there should have been scattering infections for some little distance. In fact, some infections were found up to the 14th day following the finding of the first uredinia of the season, but it was deemed proper to include as definite first generation infections only those found within 10 days.

Observations made near the villages of Essex and Whallonsburg in Essex County, New York, in 1918, gave similar results. The most promising situations were surveyed, and on June 15, before the second generation of urediniospores appeared, many first generation centers were located near the central points of the larger areas. It was a simple matter to establish aecium-free areas with a quarter mile radius, that is, centers consisting of first generation uredinia one-quarter of a mile from any pine whatsoever. Little attention was paid to these, however, as longer distances were sought. Center J had no pines whatever within 1240 yards—nearly three-quarters of a mile. The center consisted of but one uredinial spot upon a *Ribes cynosbati* bush on the edge of a small swamp surrounded by meadowland, more than half a mile from any road. Centers E and F

had no pines at all within 800 yards and only one within 1100 yards. This pine was a small one fifteen feet tall. Close inspection revealed no blister rust, and several *R. cynosbati* bushes in the fence-row nearby not only had no disease at the time of inspection, but remained healthy all summer. Center A likewise had a small pine 15 to 20 feet tall within a half-mile radius. The pine grew by the side of a road and had been trimmed so that there was not a great amount of foliage. It was easily climbed and inspected minutely, and found to be free of infection. Three *R. cynosbati* bushes directly under it were uninfected at that time and remained so all summer. With reference to centers E, F and A, it is probable that there were no aecial infections within the maximum distance given.

In considering the above cases it may be assumed that the wind carried the aeciospores through the air at least one and one-fourth miles in one instance, although it may be objected that the spores might have been brought by other agencies, such as vehicles, dogs, horses, cattle, etc. In the Minnesota study, such possibilities are very remote. There were too many infected bushes over too wide an area to be attributed to such agencies, especially when there is a heavily infected pine lot in the vicinity. In the New York area, the three-quarters-mile center was more than half a mile across hay meadows, where neither vehicle nor animal transmission need be considered.

Further objections may arise with reference to the possible overwintering of spores of *Cronartium ribicola*, which might start infection of the Ribes at distant points from diseased pine. The possibility of *C. ribicola* spores retaining their viability through the winter has been demonstrated by Miss Dosdall (1) in the case of aeciospores, and by York and Spaulding (2) and Miss Taylor (3) for urediniospores, but thus far, there is no case on record in which it has been proved that overwintering spores have started natural infections on Ribes. And furthermore, while it is possible that isolated infections might arise from overwintering spores, no one has yet maintained that overwintering could be responsible for infections on such a scale as at Whallonsburg in New York, where 25 per cent of the bushes over ten or twelve square miles were diseased, to say nothing of the much more intense infection at Rush Lake in Minnesota.

SPREAD OF UREDINIOSPORES DURING A DRY SUMMER

Late in June, 1918, in Essex County, New York, just prior to the appearance of the third generation of urediniospores, the relatively slight degree of infection of the Ribes bushes in an area where the pines were generally affected was so pronounced as to invite further attention. It was expected that by the last of June the third generation would have

appeared, accompanied by considerable dissemination of the disease. What was actually found, however, was that the third generation appeared some days later than was expected and that it had not sprung up either over a wider area or much more heavily within the area restricted by the bounds of the primary uredinial infection. Infections were found to be confined to the same bushes noted as infected earlier in the season and not to have spread to nearby bushes, and said infections were still confined to portions of the bushes within a small radius of the primary infections. Some bushes, of course, were entirely infected, but it was evident that they had been heavily and generally infected by aeciospores at first. Other bushes showed but one isolated branch infected, perhaps one extending out from the body of the bush. Still others showed localized infections of spherical or conical shapes, with the first generation of uredinia at the center of a group of leaves or at the apex of a cone of infected leaves.

Two plots, one at Lewis, and another at Whallonsburg, New York, were put under observation. The plot at Lewis consisted of ninety-nine bushes of *Ribes cynosbasti* and *R. rotundifolium* beneath and around two infected pines to a distance of about 100 yards, partly in medium aged pine growth and partly in open pasture. The plot at Whallonsburg included about seven square miles and was for the most part open country under cultivation, with very little land as woodlot. There was one lot of cultivated red currants. The wild Ribes were few in number and found scattered in woodlots and pastures, but for the most part along fence rows. The species were *R. cynosbati*, *R. rotundifolium* and *R. americanum*. In all, there were 102 bushes under observation. The individual bushes were tagged and numbered, and notes made on the condition of each bush, whether infected or not, the amount and extent of infection, and whether the infections were localized and restricted or general over the bush. Observations were made and notes taken thereafter every two weeks until the end of the season.[1] As the results were much the same for the two plots, even as to percentage of infections, etc., they will be discussed together and discrepancies will be pointed out. The more salient facts are presented in table 1.

Of the 201 bushes in both plots, 111 were infected by the aeciospores in the spring as shown by the number of generations of uredinia on the leaves at the time of the first observations. Of the ninety bushes not diseased in the spring, only nine (eight at Lewis and one doubtful case at Whallonsburg) contracted any disease during the summer. The remaining eighty-

[1] The final set of observations were made by Dr. L. H. Pennington and Mr. D. M. Benedict, because of the premature closing of the writer's work in that section.

one were still disease-free in the fall. Six of the eight bushes at Lewis were very slightly infected, having only two or three leaves diseased. Two bushes were moderately infected. In the case of these eight bushes at Lewis there is the possibility of dissemination by horses and cattle pastured in the lot, or by berry-pickers. Eight bushes (five at Lewis and three at Whallonsburg) found diseased in July were not diseased in September, probably because the infected leaves had fallen off.

There was very little dissemination from diseased to healthy bushes during the summer, and the spread within the originally infected bushes was slow and restricted in most cases. That is, the spread was what might be termed localized, in contradistinction to a general spread. In fourteen of the bushes at Lewis, the spread was general; the leaves became infected all over the bush so that there were no well-defined centers or groups of diseased leaves. In the centers or groups of leaves, more or less spherical

TABLE 1

Combined results of the observations on dissemination of the urediniospores of Cronartium ribicola during the dry summer of 1918 at Lewis and Whallonsburg, New York

	TOTAL NUMBER OF BUSHES	NUMBER INFECTED IN SPRING	NUMBER INFECTED IN FALL	SPREAD LOCAL BY FALL	NO SPREAD BY FALL	SPREAD GENERAL BY FALL
Lewis	99	59	62*	45	0	14
Whallonsburg	102	52	50*	43	9	0
Totals	201	111	112	88	9	14

* Eight bushes at Lewis uninfected in the spring contracted the rust during the summer, but five of those originally infected in the spring lost their infected leaves and were not diseased in the fall. At Whallonsburg, one new bush became diseased, but three of those diseased in the spring were not diseased in the fall.

or conical in shape (cf. "infection cone" in case of bitter-rot of apple (4), p. 37, (5), p. 12, and (6), p. 576), the original dried-up lesions with browned and dried uredinia could usually be made out, surrounded by lesions with their uredinia in various stages, from old to fresh, bright-colored ones. Such centers or groups of infected leaves appeared as if the whole had originated from one or more uredinial spots, presumably from aeciospore infection, and that then each succeeding generation of uredinia had sprung up quite locally and within a very short distance of the preceding sporulating uredinia. At the time of the third generation of uredinia, the case was very plain. The new uredinial spots and uredinia were bright and fresh (third generation), there were a number of older uredinia, brown and faded in color with the spots drying up (second generation), and in the midst of all these, one dried leaf or more bearing old darkened uredinia (the first generation). Such local infections—using "infections" here

to signify these definable groups of infected leaves—were observed during the course of the summer, and it was evident that they preserved their individuality for the most part until late in August, increasing a little in size with each generation until all the leaves on the bush were attacked. As mentioned, fourteen bushes at Lewis were infected generally early in the season. Nine of those at Whallonsburg did not develop any more disease than was evident in the spring. But the remaining eighty-eight all gave evidence, both at the time of the third generation in early July and during the remainder of the summer, of this restricted, localized uredinial dissemination.

Intensity of the disease within the different bushes is a different matter, for dissemination might be general and yet not be very intense, or localized and yet heavy. The point to be brought out is that in about 70 per cent of the cases (70 in 102) where any increase in amount of disease was evident during the season, the rust, though spreading slowly and quite locally, proceeded to the point of defoliating the bushes.

From a similarity of results obtained from the two quite different plots, it appeared as if the dissemination of the blister rust on the Ribes was quite materially checked in this locality in 1918. One would naturally turn to the weather conditions for an explanation. The summer of 1918 was a dry one in Essex County, New York, particularly around Lewis where it is very sandy. Up to the middle of July there was an abundance of rain, but from July 17 to September 3 it was hot and dry. There were but few showers and there were four stretches of four to seven days without any rain at all. There were but three generations of uredinia between the first of July and the middle of September, the third about July 20, the fourth about August 19, and the fifth about September 12. The month of September was one of rain and high humidity. During this period the generations of uredinia could not be so easily distinguished because there was plenty of moisture to induce the formation of uredinia at any time. Much of the season's increase of disease upon the Ribes occurred at this time. It appears, therefore, that dry weather is likely to prevent general dissemination of the white pine blister rust by urediniospores.

SUMMARY

Observations show that the aeciospores of *C. ribicola* can be blown more than one and one-fourth miles and infect Ribes. One center noted was one and one-quarter miles from any pine whatsoever.

Dry weather prevented a wide distribution of the disease by urediniospores during the sumer of 1918 in Essex County, New York.

OFFICE OF INVESTIGATIONS IN FOREST PATHOLOGY
BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C.

LITERATURE CITED

(1) DOSDALL, LOUISE: Overwintering of the aeciospores of Cronartium ribicola. Phytopathology **8**: 619. 1918.

(2) YORK, H. H., AND SPAULDING, PERLEY: The overwintering of Cronartium ribicola on Ribes. Phytopathology **8**: 617–619. 1918.

(3) TAYLOR, MINNIE W.: The overwintering of Cronartium ribicola on Ribes. Phytopathology **9**: 575. 1919.

(4) SCHRENK, HERMAN VON, AND SPAULDING, PERLEY: The bitter rot of apples. U. S. Dept. Agr. Bur. Plant. Indus. Bul. 44, 54 p., 9 pl. 1903.

(5) SCOTT, W. M.: Control of apple bitter-rot. U. S. Dept. Agr. Bur. Plant. Indus. Bul. 93, 33 p., 8 pl. 1906.

(6) BURRILL, T. J.: Bitter rot of apples. Ill. Agr. Expt. Sta. Bul. 118: 555–608, illus. 1907.

HEAT INJURY TO BEANS IN COLORADO

H. G. MacMillan and L. P. Byars

With One Figure in the Text

In Colorado the month of June, 1919, was marked by quite extreme conditions of temperature. The month began with a record-breaking cold snap. At Greeley the thermometer fell to 29° F. on the second, and 28° F. on the third. At the end of the month high temperatures were experienced for a few days. The thermometer rose to 102° F. on the 28th, and 104° F. on the 29th. For the month, as a whole, the temperature averaged about normal.

These extreme conditions were evident in the appearance of the vegetables. The early planted crops were quite badly frosted, especially those in the seedling stage. Beans are usually planted about the middle of May or soon thereafter, and were in the tender, seedling stage on the second of June when the frost came. This killing frost made necessary the reseeding of considerable areas, which was done as soon as seed could be procured and planted. The planting of the second crop was done between the fifth and twelfth of June.

At the end of the month the second-crop beans were in the seedling stage, just acquiring the first two leaves or bringing them to full size. In fields on sandy land a very serious condition was noted, not readily accounted for at the time. The stems were shrunken at the ground line, the upper part falling or leaning over so that the leaves touched the ground. Many of the leaves were not noticeably wilted, although the first appearance of the plant suggested wilt from drought. Macroscopic examination revealed the underground stem and roots to be in normal condition. The stems were later examined for evidence of a damping-off fungus or other parasitic organisms, but no such organisms were found upon the seedling plants. The plants were not suffering from lack of water.

The plants shown in figure 1 exhibit typical symptoms of the malady. The stem had collapsed at the point just at or below the surface of the ground, and the tissues were shrunken and collapsed, though not dry. The collapsed tissues were not materially different in color from the turgid parts of the stem, and usually the epidermis remained unbroken. As no organism appears concerned in the attack, and because of the high temperatures, especially at the surface of the soil, prevailing at the time the injury first became apparent, it is presumed that the trouble was caused entirely by excessive heat. No records are available which have a direct bearing on the conditions in fields where this trouble occurred. However,

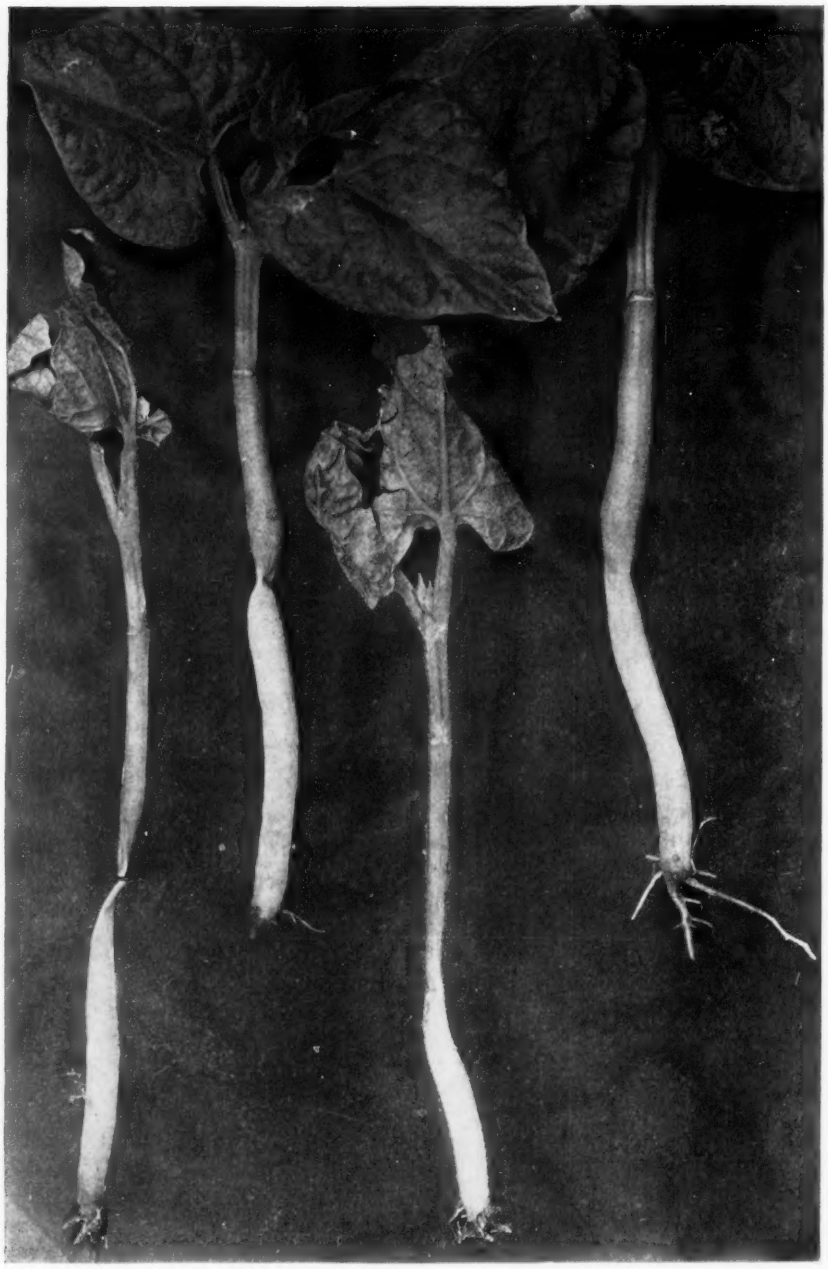

FIG. 1. BEAN SEEDLINGS AFFECTED BY HEAT INJURY

Note the slightly shrunken stems and turgid leaves of the upper seedlings, which are not seriously affected, and the seriously shrunken stems and wilted leaves of the lower seedlings, which are badly injured. Plants collected June 30, 1919, from a sandy field near Greeley, Colorado, and photographed natural size.

a few miles away, at the Colorado Potato Experiment Station, soil temperatures were being taken in a potato experimental plot. The records were taken at depths of one and three inches below the surface, but none at the surface of the ground.

At a depth of 1 inch the temperature averaged 109.8° F. for the last ten days of June, rising to 112° on the 27th and 28th, and 113° on the 29th and 30th. At the same time, the ten-day average for the 3-inch depth was 92.3° F., the temperature reaching 94° F on the 27th and 28th, 96° F. on the 29th, and 95° F. on the 30th. The air temperature averaged 99.3° F. for the last ten days of June, rising to 104° F. on the 29th and 101° F. on the 30th. For the few days succeeding, the temperature was lower.

The soil temperatures given are only indicative. The soil upon which the beans were growing was quite light and sandy, and very hot. The soil at the Station was a Billings loam, a medium heavy soil, not becoming smooth on the surface under the influence of rain or irrigation water, as the sand would do. A year or more earlier at the Station some soil surface observations were taken with a mercury thermometer shaded from the sun. It was found then that it rose readily to 125° and 130° F. No doubt the beans were exposed to a temperature of 130° F. or higher for two or three hours each day, resulting in the heat injury. The plants which had suffered to the extent of being prostrated did not survive.

Hartley's[1] observations on stem lesions of seedlings of conifers, cowpeas, and rye, which he thought to be due to excessive heat, are of special interest in connection with the observations just presented. He found seedlings being killed both in the field and in poorly shaded nurseries, and mainly in Nebraska. The stems were collapsed and shrunken just at or a little above the surface of the soil, and in addition there was usually formed at the same place a definitely delimited lesion, which generally became white. On account of its color he described the trouble as "white spot."

The writers have not observed this characteristic "white spot" on the stems of beans in Colorado. Possibly it might have developed had higher temperatures prevailed or had other factors, such as light and moisture, been identical with those in Nebraska.

It has seemed desirable to present the above observations unsupported by experimental data, because opportunity may not permit of carrying out further investigations on the subject by the writers. Furthermore, it is hoped that this note may add something to the small amount of data available on the pathological importance of high soil temperature.

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United States Department of Agriculture
Washington, D. C.

[1] Hartley, Carl. Stem lesions caused by excessive heat. Jour. Agr. Research **14**: 595-604, fig. 1. 1918.

BRIEFER ARTICLES

NOTE ON RESISTANCE OF CHESTNUT TO THE BLIGHT

J. Franklin Collins

With Two Figures in the Text

Ever since the writer first became actively interested in the chestnut blight (*Endothia parasitica* (Anders.)Murrill) in 1908, he has been on the lookout for suggestions of immunity or resistance in individual plants of various species of the genus *Castanea*. Many sprouts and trunks of trees that appeared to be resisting the disease, or that were suggesting immunity at the time of observation, have been noted. In nearly all of these the period of resistance or apparent immunity proved to be of comparatively short duration, though in a few cases the period extended over two or three years; rarely longer. In a great majority of such cases the apparent immunity was probably due to the uninjured condition of the bark, while temporary resistance could in some cases be rather definitely traced to an unusually vigorous growth of the host, due to particularly favorable growth conditions. Disappointing experiences of this sort were duplicated so many times between 1908 and 1913 that the writer became very reluctant to make any definite statement in reply to inquiries regarding the prospects of locating immune or resistant chestnuts other than the Japanese, to which Metcalf first called attention in 1908.[1] Obviously, no reliable final statement regarding such conditions can be made until observations have extended over quite a number of years.

However, down to the present time the writer has been constantly on the lookout for trees that showed suggestions of immunity or resistance. Hundreds of trees have been under observation during the last eleven years, and at the present time numerous trees are still under periodical observation. In general it may be stated that resistance has been more pronounced in the last few years (four or five) than in earlier years. This last statement is meant particularly to imply that in many cases observations over a greater number of years are now necessary to disprove the suspicion of immunity or resistance than was the case formerly; in other words, this apparently means that (a) the disease is progressing more slowly, or (b) the host is more successfully resisting the disease, or (c) the more susceptible trees have all been killed, or (d) some other factors, are influencing results.

[1] Bureau of Plant Industry Bulletin 121, part 6, pp. 3-4. February 10, 1908.

FIG. 1. FROM PHOTOGRAPH TAKEN NOVEMBER 13, 1912

A. The living diseased sprout particularly referred to in this article. *B*. Stump from which sprouts originated. *C*. Living sprout diseased at base. *D*. Small dead forked branch of sprout *E*. *E*. Badly diseased and practically dead sprout.

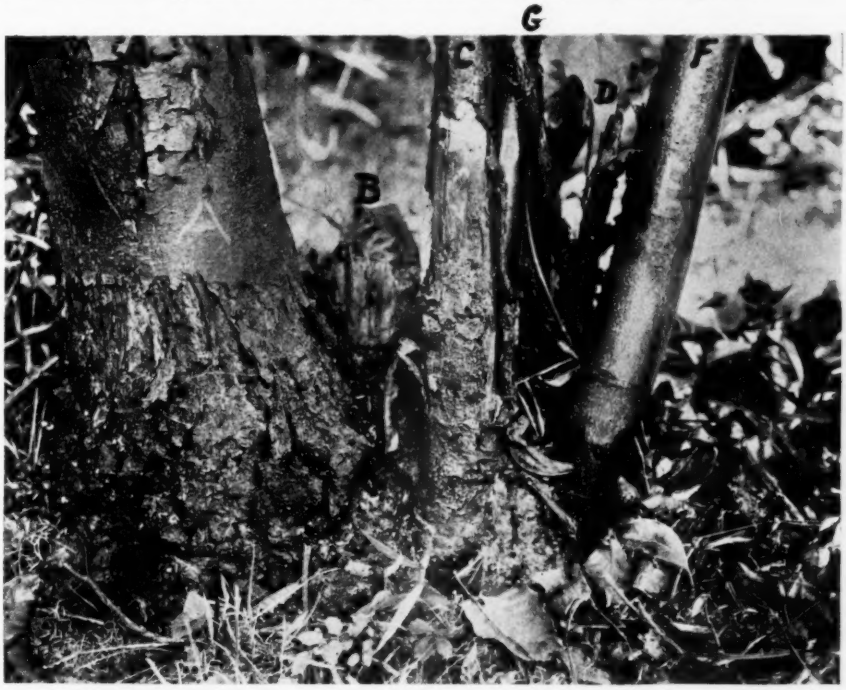

FIG. 2. PHOTOGRAPH TAKEN JULY 13, 1917 (same distance from sprouts as in fig. 1)

Letters refer to the same sprouts as in figure 1. *C*. Sprout apparently dead since 1913. *F*. New living sprout directly in front of *E*. *G*. New living sprout behind *C* and *D*.

Among the many sprouts of American chestnut trees that have come under the writer's observation, from the point of view of possible resistance, the case mentioned below seems particularly worthy of note at this time.[2]

On November 13, 1912, the writer took a photograph of some chestnut sprouts in Lancaster County, Pennsylvania, at least one of which showed a well marked, characteristic, though not an extreme, case of disease, with accompanying hypertrophy and prominent coloring at the base of the stem (fig. 1). These sprouts had evidently grown from the stump of a small tree cut three or more years earlier when the undergrowth surrounding some grafted orchard trees was mowed. The exact age of the sprouts was not determined.[3]

At the time the photograph was taken the largest living sprout was approximately $3\frac{3}{4}$ inches in girth just above the hypertrophy, and presented the same general diseased appearance as hundreds of other sprouts that died one or two years later. Much to our surprise, this sprout continued to live and grow, the hypertrophy at the base becoming less and less pronounced in subsequent years, until in 1917 the swelling was scarcely apparent, as will be seen from the accompanying illustration (fig. 2).

On the date of the latest records (September 24, 1919), the main sprout was 16 feet high and measured 1 foot $3\frac{3}{4}$ inches in girth, 1 foot from the ground. The old hypertrophy of seven years earlier was no longer in evidence, except perhaps as a rougher surface to the bark at the base. There was some suggestion of the yellow color so often accompanying the disease, in the cracks at the base, but no sign of even a faintly delimited lesion or hypertrophy. Formerly there was a disease canker two feet from the ground. This was nearly healed over in 1919. The callus surrounding it showed some old pustules, but no other external indication of active disease. Another canker ten inches long showed little evidence of disease in 1919.

Although this sprout still is diseased in several places and several twigs have been killed, there are at least three places on the main stem where disease formerly was present, but now, from external examination only,

[2] For resistance in mature trees see Graves, Arthur Harmount. Resistance in the American chestnut to the bark disease. Science n.s. **48**: 652–653. December 27, 1918.

[3] The small stump from which these sprouts grew was 4 or 5 inches high and approximately $2\frac{1}{2}$ inches in diameter on the date mentioned above. At the time of the first recorded observations on this plot no tree was indicated at this point, so the cutting undoubtedly was done prior to 1909. Like numerous other trees nearby, this may have been an American seedling tree grafted with a Japanese scion, which later was cut below the graft; but there was no evidence to prove this. The existing sprouts are of the ordinary American chestnut, so far as can be judged from foliage specimens only.

is apparently absent or very nearly so; moreover, the foliage of the crown appears to be essentially normal. No cutting to ascertain the condition of the inner bark has been made at any time.

Between the years 1912 and 1917, the sprout increased in girth from $3\frac{3}{4}$ inches to $13\frac{1}{2}$ inches, an average yearly increase of nearly 2 inches. In the subsequent two years, the average yearly increase was $1\frac{1}{8}$ inches.

Of course, no prophecy can be made as to the probability of the sprout finally entirely overcoming the disease, but the fact that any badly diseased sprout, but little over an inch in diameter, should survive seven years and increase to a diameter of approximately five inches in that time seems specially worthy of note.

Perhaps some reader may recall instances of resistance that have been observed; if so, the writer would be glad to hear of them.

INVESTIGATIONS IN FOREST PATHOLOGY
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NOTE ON THE PATHOLOGICAL EFFECTS OF BLAZING TREES

JAMES R. WEIR

Wounds in trees susceptible to infection serve cull-producing fungi in two ways. A fungus already in the heartwood is enabled to penetrate the exposed tissues and produce sporophores in exactly the same manner that sporophores are produced from branch knots and injuries caused by fire and weather; secondly, wounds are a source of infection from without.

The danger of infecting conifers through mechanical wounding, such as blazes, logging scars, and various injuries to the sapwood attending general forest improvement work, largely depends upon the quantity of resin secreted from the exposed surface. For the present purposes the conifers of this region are classified as resinous and non-resinous species. This classification is based entirely on whether or not a tree when blazed secretes a protective coat of resin. The usual anatomical classification is disregarded. A wound in the sapwood of a resinous species is almost immediately protected from infection by a heavy exudation of resin, which is not the case in the latter group. With this observation as a basis, a large number of blazes during the past seven years have been examined in Montana and Idaho, to determine their relation to the entrance or exit of cull-producing fungi, as evidenced by the presence of sporophores on the exposed wood, special attention being given to blazes because they are preventable.

Results of this study are embodied in table 1.

The sporophores found on the blazes were of the following species: *Trametes pini*, *Fomes pinicola*, *Fomes laricis*, *Hydnum* sp. (unnamed), *Echinodontium tinctorium*, and *Pholiota adiposa*, and are the species which are responsible for most of the cull in the trunks of coniferous trees in the region studied. *Trametes pini* is more or less common to all conifers, as is *Fomes pinicola*, which is frequently a wound fungus. *Fomes laricis* is chiefly associated with larch in the region studied. The last three named species are practically confined to hemlocks and firs.

The foregoing shows quite clearly the rôle blazes play in the development of sporophores, also that blazes in non-resinous conifers are a more prolific source of sporophore production than in resinous species. The table shows

TABLE 1

Number and species of conifers examined, number of wounds on each class, and number of wounds bearing sporophores for each class

	NUMBER OF WOUNDS BEARING SPOROPHORES						NUMBER OF WOUNDS EXAMINED						NUMBER OF TREES EXAMINED					
	WP*	L	DF	LPP	YP	Total	WP	L	DF	LPP	YP	Total	WP	L	DF	LPP	YP	Total
Resinous trees	2	2	3	2	1	10	13	12	10	12	7	54	25	32	21	12	9	99
	AF	ES	GF	WH			AF	ES	GF	WH			AF	ES	GF	WH		
Non-resinous trees	20	10	25	8		63	15	10	21	4		50	10	23	25	20		78
Total						73						104						177

*WP = Western white pine.
L = Western larch.
DF = Douglas fir.
LPP = Lodgepole pine.
YP = Western yellow pine.
AF = Alpine fir.
ES = Engelmann spruce.
GF = Grand fir.
WH = Western hemlock.

86 per cent more sporophores on wounds of conifers listed as non-resinous species than on resinous species. Though anatomically belonging to the resinous group, Engelmann spruce is here listed with the non-resinous species, owing to the fact that blazes on this tree do not secrete resin as readily or in as large a quantity as is the case in pines, and that such wounds more frequently bore sporophores than was the case with the trees listed as resinous. These sporophores may have developed from mycelia already in the heartwood of the trees, a condition to be expected in a study of this kind. The spruce in the regions chiefly studied was very defective. The wood of spruce, however, is by no means as resinous as that of the pines.

The danger from blazes may be largely eliminated by making light blazes in the bark and bast which will, in most cases, be quite sufficient for the purpose in hand, and are not readily susceptible to infection. This is particularly true in the case of thick bark trees. By careful manipulation of the ax a blaze in any tree may be made in the bark without injury to the wood, and spores which may be carried on the ax will not find a suitable substratum. The practice of using tags, as in the case of marking trees on timber sale operations, is an excellent plan. Since they are put on with tacks or small nails and would come off in the slab on sawing, and do not afford an entrance to fungi, their use should be encouraged.

SUMMARY

On the basis of resin secretion from blazes, conifers are classified as resinous and non-resinous. An examination of a number of blazes from each class shows that they play an important part in the development of sporophores of cull-producing fungi, and that blazes in non-resinous species are a more prolific source of sporophore production than in resinous species.

OFFICE OF INVESTIGATIONS IN FOREST PATHOLOGY
BUREAU OF PLANT INDUSTRY
SPOKANE, WASHINGTON

ALBERT THOMAS BELL

C. W. EDGERTON

WITH PORTRAIT

Albert Thomas Bell was born at Biggsville, Illinois, October 6, 1866, and died at Baton Rouge, Louisiana, July 27, 1919. When he was fifteen years of age, his parents moved to Furnas County, Nebraska, and a year later he entered the Lincoln (Nebraska) High School. He was unable to finish his preparatory training, and while less than eighteen years of age he began teaching in the rural schools of Furnas County. After teaching in the rural schools for five years and in the Crete (Nebraska) High School for seven years, he entered the University of Nebraska, from which he received his B.S. degree in 1898 and his A.M. degree in 1900. He specialized in botany and was made a member of Sigma Xi at that institution. After leaving the University, he taught in the Lincoln (Nebraska)

High School for two years and in the Nebraska Wesleyan University for eight years. For the last nine years of his life, he was professor of botany in the University of Louisiana.

Professor Bell was an exceptional teacher and was deeply interested in his chosen profession. The late Prof. Chas. E. Bessey, under whom he did his university work, once stated to the writer that he considered Pro-

fessor Bell one of the best teachers that had ever been in his department. He spent his whole life in teaching and it can be truthfully said that he died in harness as he had a stroke of apoplexy while on a field trip with some of his students, dying within less than forty-eight hours without regaining consciousness.

Professor Bell was married in 1892 to Miss Belle Cooper, who still survives him.

PHYTOPATHOLOGICAL NOTES

FIG. 1. ROOT OF AN AZALEA BUSH KILLED BY SHOE-STRING ROOT ROT

Shoe-string root rot of Rhododendron and Azalea caused by Armillaria mellea Vahl. *Armillaria mellea* has been reported as causing important root rots of various kinds of coniferous trees and deciduous trees and shrubs. It is the purpose of the present note to report an extreme case of root rot of Rhododendron and Azalea caused by this fungus in the Northwest.

A group of Rhododendrons and Azaleas in a large bed of these shrubs was noticed to die during the spring of 1915. On being examined it was found that the root systems were almost completely enveloped by rhizomorphs of *Armillaria mellea*. Little attention was paid to the matter until the following spring when it was observed that more of the shrubs had been killed. The infected area is still gradually enlarging.

The general appearance and the extent of the infection on an Azalea root system is shown in figure 1.

HENRY SCHMITZ

Personals. Mr. L. O. Watson has resigned his position as pathological adviser in the Office of Cotton, Truck and Forage Crop Disease Investigations, Department of Agriculture, to engage in a private seed-growing business at Florence, S. Car.

Mr. Geo. M. Armstrong, recently a graduate student at Washington University, St. Louis, has accepted the position of assistant pathologist in the Bureau of Plant Industry and has taken up work on the control of the root-knot nematode.

Mr. Freeman Weiss, formerly a joint employee of the Department of Agriculture and the Minnesota Agricultural Experiment Station, engaged

in the investigation of cereal diseases, has accepted a full time appointment as assistant pathologist in the Department of Agriculture and is engaged in the investigation of the potato wart disease.

Mr. N. Rex Hunt of the Office of Forest Pathology Investigations, Bureau of Plant Industry, has been transferred to the Federal Horticultural Board to assist in the eradication of the potato wart disease.

Dr. Charles Drechsler has been transferred from the Office of Cereal Investigations, Bureau of Plant Industry, to the Office of Cotton, Truck and Forage Crop Disease Investigations and has taken up the investigation of vegetable decays and decay-producing organisms, with headquarters at Brooklyn, New York.

Mr. D. C. Neal has resigned the position of plant pathologist for the Georgia State Board of Entomology to accept a similar position at the Mississippi Agricultural Experiment Station.

Mr. C. M. Tucker, a recent graduate of the University of Missouri, has been employed by the Extension Division of the Florida College of Agriculture to conduct extension work on the control of watermelon diseases.

Dr. R. O. Cromwell has resigned from the Office of Cereal Investigations, U. S. Department of Agriculture, in order to accept a position as crop specialist with the firm of E. W. Wagner & Co., Chicago, Ill.

Dr. W. H. Weston returned to Washington, D. C., on April 29. Since December, 1917, he has been in the Orient, principally the Philippines, studying the downy mildew of corn.

Dr. F. Kolpin Ravn, of Denmark, visited Washington in May, and addressed the Botanical Society of Washington May 4, on Plant Pathology in Denmark in recent years. We record, with deepest regret, the sudden death of Dr. Ravn, from blood poisoning, on May 25, at the home of his wife's parents, at East Orange, New Jersey.

LITERATURE ON PLANT DISEASES[1]

COMPILED BY ALICE C. ATWOOD AND FLORENCE P. SMITH, BIBLIOGRAPHICAL ASSISTANTS, BUREAU OF PLANT INDUSTRY

April, 1920

Bailey, M. A. Puccinia malvacearum and the mycoplasm theory. Ann. Bot. **34**: 173–200, illus. Ap. 1920.

Barbosa Rodrigues, João, Jr. A morte das roseiras em Belém do Pará. Bol. Min. Agr. Indus. e Com. Brazil **7**: 67–72. 1919.

Benaiges de Aris, Carmelo. Un caso de "gommosis" en las viñas replantadas de Peñafiel (Valladolid). Bol. Agr. Téch. y Econ. Madrid **12**: 36–41. Ja. 1918.

Undetermined bacterium.

Bernatsky, Jenö. Die Kriterien der reifen und unreifen Rebe. Ztschr. Pflanzenkrank. **26**: 37–46, illus. Ap. 1916.

Boncquet, Pierre Auguste, and **Boncquet, Mary.** Presence of nitrites and ammonia in diseased plants. II. Oxidases and diastases; their relation to the disturbance. Jour. Amer. Chem. Soc. **39**: 2088–2093. S. 1917.

Borzi, [Antonino]. Commemorazione del compianto socio Giovanni Briosi. Atti R. Accad. Lincei V. Rend. Cl. Sci. Fis., Mat. e Nat. **29** (1): 118–123. 1920.

Butler, Ormond Rourke. Report of the department of botany. New Hampshire Agr. Exp. Sta. Rpt. [**1917**] **18**: 17–20. 1919.

Chambers, Charles Oscar. Report of the botany department. Oklahoma Agr. Expt. Sta. 28th Ann. Rpt. (**1918**) **19**: 33–34. 1919.

Cockayne, A. H. Fire-blight. A serious disease of fruit-trees. New Zeal. Jour. Agr. **20**: 156–157. Mr. 1920.

See also, p. 181–182.

Cotton, Arthur Disbrowe. Clover stem-rot. (Sclerotinia trifoliorum Erik.) Jour. Min. Agr. Gt. Brit. **26**: 1241–1244, pl. Mr. 1920.

Cromwell, Richard Oliver. Fusarium blight of the soy bean and the relation of various factors to infection. Nebraska Agr. Expt. Sta. Research Bul. 14, 43 p., illus. 1919.

Literature cited, p. 42–43.

Dana, B. F., and **Zundel, George L.** Head smut of corn and sorghum. Washington Agr. Expt. Sta. Pop. Bul. 119, 6 p., illus. 1920.

Sphacelotheca reiliana.

[1] This list includes references, both American and foreign, to the literature of plant pathology and mycology of interest to pathologists. Foreign references published since January 1, 1917, have been included beginning with the list appearing in v. 7, no. 3, June, 1917.

All authors are urged to cooperate in making the list complete by sending their separates and by making corrections and additions, and especially by calling attention to meritorious articles published outside of regular journals. Reprints or correspondence should be addressed to Miss E. R. Oberly, Librarian, Bureau of Plant Industry, U. S. Dept. of Agric., Washington, D. C.

Dowson, Walter John. Wheat in East Africa. Bul. Dept. Agr. East Africa Protect. 4, 16 p. 1919.

VIII. Fungous diseases, p. 13–16.

Rust—*P. graminis, P. glumarum, P. triticina;* loose smut of wheat, *Ustilago tritici; Cladosporium herbarum.*

Abstracts giving especially resistance tests in Roy. Gard. Kew, Bul. Misc. Inform. **1920:** 78–79, Mr. 1920.

Edgerton, Claude Wilbur, and **Moreland, C. C.** Effect of fungi on the germination of sugar cane. Louisiana Agr. Expt. Sta. Bul. 169, 40 p., 9 pl. 1920.

Bibliography, p. 37–39.

Ehrenberg, Paul. Der Einfluss des Bodens und der Düngung auf Pflanzenkrankheiten. Fühlings Landw. Ztg. **68:** 401–412. N. 1/15, 1919.

Esmarch, F. Die Phloëmnekrose der Kartoffel. Ber. Deut. Bot. Gesell. **37:** 463–470. Ja. 1920.

Bibliographical footnotes.

Fawcett, George L. The yellow stripe or mosaic disease in the Argentine. Louisiana Planter **44,** no. 3: 41. Ja. 17, 1920.

Reprinted in Agr. News [Barbados] **19:** 110, Ap. 3, 1920.

Ferdinandsen, Carl, and **Winge, Ojvind.** A Phyllachorella parasitic on Sargassum. Mycologia **12:** 102–103, illus. Mr. 1920.

P. oceanica sp. nov.

Germano de Sousa, Raul. Molestia das capsulas do algodoeiro. Bol. Agr. [São Paulo] **19:** 477–478, illus. May/Jy. 1918.

Probably due to *Bacillus gossypinus; Colletotrichum gossypii* also found.

Geschwind, A. Die der Omorikafichte (Picea omorica Panc.) schädlichen Tiere und parasitischen Pilze. Naturw. Ztschr. Forst. u. Landw. **16:** 387–395. N./D. 1918.

2. Die parasitischen Pilze, p. 393.

Notes of occurrence of *Herpotrichia nigra* Hrtg. *Lophodermium macrosporium, Trametes pini.*

Grisdale, J. H. Report of acting dominion botanist. *In* Rpt. Dominion Expt. Farms **1918/19:** 57–61. 1920.

Groom, Percy. Brown oak. Quart. Jour. For. **14:** 103–109. Ap. 1920.

"Brown oak owes its origin to the activities of one kind of fungus at least."

Guérin, Paul, and **Lormand, Ch.** Action du chlore et de diverses vapeurs sur les végétaux. Compt. Rend. Acad. Sci. [Paris] **170:** 401–403. 1920.

Henning, Ernst. Åtgärder mot sot hos havre och korn. Centralanst. Jordbruksförsök [Stockholm] Flygblad 72 [bis], 4 p., illus. Mr. 1920.

Hiley, W. E. The fungal diseases of the common larch. 204 p., 72 fig. Oxford, 1919.

Ideta, Arata. Preliminary report on the plant diseases in Yamaguchi prefecture, Japan. no. 1–2. [Ja.–F. 1920.]

In Japanese.

Broadsides.

Jackson, Herbert Spencer. [Report of the department of] botany. Indiana Purdue Agr. Expt. Sta. 32d Ann. Rpt. [**1918**]/**19:** 19–25, illus. 1919.

Keuchenius, P. E. Onderzoekingen over bruine bastziekte. Arch. Rubbercult. Nederl. Indië **4:** 1–4, fold. tab. F. 1920.

English summary, p. 4.

Leach, Julian Gilbert. Report of [acting] botanist. Colorado Agr. Expt. Sta. 32d Ann. Rpt. [**1918**]/**19:** 13–17. 1919.

Leonian, Leon H. Fusarium wilt of Chile paper. New Mexico Agr. Expt. Sta. Bul. 121, 32 p., illus. 1919.
Literature cited, p. 31.
F. annuum n. sp.

Lutman, Benjamin Franklin. Resistance of potato tubers to scab. Vermont Agr. Expt. Sta. Bul. 215, 29 p., 5 pl. on 3. 1919.

——— Tip burn on the potato and other plants. Vermont Agr. Expt. Sta. Bul. 214, 28 p., illus., 2 pl. on 1. 1919.
Bibliography, p. 28.

Martin, J. F., Stene, Andrew Edward, and **Sheals, Ralph A.** How to distinguish and combat the white pine blister rust. Bul. Ent. Dept. Rhode Island State Bd. Agr. n. s. no. 1, 38 p., illus. F. 1920.

Meier, Fred Campbell. Control of watermelon anthracnose by spraying. U. S. Dept. Agr. Circ. 90, 11 p., illus. Mr. 1920.

Morris, Robert T. Hazel nuts. Amer. Nut Jour. **12:** 57, illus. Ap. 1920.
Hazel blight (*Cryptosporella anomala* Sacc.).

Murphy, Paul A. Potato inspection service in 1919. Agr. Gaz. Canada **7:** 308–310. Ap. 1920.

Mysore. Agricultural Department. Biological Section. [Report] mycology. Rpt. Work Agr. Dept. Mysore. **1916/17:** 22–24. 1918.
Diseases of supari. Mildew of mango. Diseases of coffee. Spike disease of sandal. Miscellaneous work.

Neger, Franz Wilhelm. Ueber eine merkwürdige Schädigung der Obstes (Apfel) durch saure Rauchgase. Ztschr. Obst- u. Gartenbau n. F. **45:** 177–179, illus. 1919.

Nicolas, G. Sur respiration des plantes parasitées par des champignons. Compt. Rend. Acad. Sci. [Paris] **170:** 750–752. 1920.

Nowell, William. A root disease of cacao in Trinidad, Rosellinia pepo, with an introductory note by W. G. Freeman. Bul. Dept. Agr. Trinidad and Tobago **18:** 178–199, 3 pl. 1919.

Osborn, Theodore George Bentley. Annual report of the consulting botanist and vegetable pathologist 1917/18–1918/19. Reprinted from Ann. Rpt. Min. Agr. So. Aust. 1917/18–1918/19. 2 no. (3 p. each). 1918–19.

Osmun, Albert Vincent. [Report of the] department of botany. Massachusetts Agr. Expt. Sta. 31st Ann. Rpt. **1918** (I–II): 20a–26a. 1919.

Paine, Sydney G., and **Bewley, W. F.** Studies in bacteriosis IV. "Stripe" disease of tomato. Ann. Appl. Biol. **6:** 183–202, illus., pl. 8. D. 1919.
References, p. 202.
Bacillus lathyri.

Pantanelli, Enrico. Influenza della nutrizione e dell'attività radicale sul collasso e il dissoccamento prodotti dal freddo. Atti R. Accad. Lincei V. Rend. Cl. Sci. Fis. Mat. e Nat. **29** (1): 66–71. 1920.

Paravacini, Eugen. Favolus europaeus Fr. Ein Schädling des Nussbaumes. Schweiz. Ztschr. Forstw. **70:** 15–17. Ja./F. 1919.

Petch, Thomas. Fungus diseases in Ceylon. Planters' Chron. **15:** 190–192, 205–208. Mr. 13–20, 1920.
Abstract of his report to the Planters' Assoc. Ceylon, 1919.

——— Notes on fungus diseases during 1918. Yearbook Planters' Assoc. Ceylon **1918** (65th Ann. Rpt.): 79–81 1918.

Reinking, Otto A. Higher Basidiomycetes from the Philippines and their hosts. I. Philippine Jour. Sci. **15:** 479–490. N. 1919 [Mr. 1920].

Roldan, Angel. Los arboles indigenas que ataca el muerdago en el Valle de Mexico. Datos para la flora forestal del Distrito Federal. Mem. Soc. Cient. Ant. Alzate **37:** 17–21, pl. 4. My. 1918.

Trees attacked by *Phoradendron brachystachyum* and *P. velutinum.*

Rolfs, Fred Moss. Report of horticultural department. Oklahoma Agr. Expt. Sta. 28th Ann. Rpt. [**1918**]/**19:** 44–50. 1919.

Rosen, Harry Robert. The mosaic disease of sweet potatoes. Arkansas Agr. Expt. Sta. Bul. 167, 10 p., 5 pl. on 3. 1920.

List of references, p. 9.

Schaffnit, Ernst. Aufgaben Ziele und volkswirtschaftliche Bedeutung der praktischen Pflanzenschutzes. Nach einem Vortrag gehalten auf den verbandstage landlicher Genossenschaften. e.v. Coblenz am 10. September 1919 in Cöln. 8 p., fold. map. [Neuweid, 1919.]

Seaver, Fred Jay. Notes on North American Hypocrales. IV. Aschersonia and Hypocrella. Mycologia **12:** 93–98, pl. 6. Mr. 1920.

Stahel, Gerold. Bijdrage tot de kennis der krullotenziekte. Bul. Dept. Landw. Suriname 39, 34 p., 8 pl. 1919.

Literatuur-opgave, p. 32.

Stevenson, John A. Enfermedades del citro en Puerto Rico (Cont.). Rev. Agr. Puerto Rico **4,** no. 3: 34–46. Mr. 1920.

Subramaniam, L. S. A Pythium disease of ginger, tobacco and papaya. Mem. Dept. Agr. India Bot. Ser. **10,** no. 4: 181–194, 6 pl. (partly col.). D. 1919.

Pythium butleri n. sp.

Tunstall, Arthur C. A note on the canker on Albizzia spp. Quart. Jour. Sci. Dept. Ind. Tea Assoc. **1918:** 13–14. 1918.

Due to a species of Polyporus.

U. S. Department of Agriculture. Federal Horticultural Board. Report [1918]/19, 32 p. 1919.

——— **Bureau of Plant Industry. Plant Disease Survey.** Plant disease bulletin. Sup. 7 (index to Sup. 1–6): 214–241. Ag. 15, 1919.

Vercier, J. Combattons la chlorose des arbres fruitiers en Juillet. Progr. Agr. et Vit. **72:** 9–10. Jy. 6, 1919.

Treatment with iron sulphate.

Waldron, Lawrence Root, and **Clark, Jacob Allen.** Kota, a rust-resistant variety of common spring wheat. Jour. Amer. Soc. Agron. **11:** 187–195, pl. 7. My. 1919.

Waterhouse, W. L. A note on the over-summering of wheat rust in Australia. Agr. Gaz. N. S. Wales **31:** 165–166. Mr. 1920.

Waters, R. Take-all disease in wheat. Incidence in New Zealand. New Zeal. Jour. Agr. **20:** 137–143, illus. Mr. 1920.

Fig. 3: Diagrams of fungus *Ophiobolus graminis.*

Wormald, H. The "brown rot" diseases of fruit trees, with special reference to two biologic forms of Monilia cinerea, Bon. II. Ann. Bot. **34:** 143–171, pl. 4–5. Ap. 1920.

——— A Phytophthora rot of pears and apples. Ann. Appl. Biol. **6:** 89–100, illus., pl. 3. D. 1919.

Bibliography, p. 100.

Phytophthora cactorum.

Zuber, Neill D. Report of division of plant pathology. 11th Ann. Rpt. Comr. Agr. Texas [**1917**]/**18:** 40–44. 1919

Division organized in 1915, B. C. Tharp, plant pathologist, 1915–17.

SOUTHERN DIVISION

MEETING OF THE SOUTHERN DIVISION OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

The second annual meeting of the Southern Division of the American Phytopathological Society was held at Atlanta, Georgia, February 24 and 25, 1920, in conjunction with the meeting of the Southern Agricultural Workers. Pathologists from most of the southern states were present and took part in the round table discussions. C. W. Edgerton, president of the Southern Division, presided during the discussions.

The meeting of the first day was a joint session with the Southern Horticulturists and the program was limited to papers and discussions on sweet potato problems. The program of the second day consisted of discussions on some of the phytopathological problems which are receiving most attention in the Southern States. The program follows:

February 24. Sweet potato problems

Fertilizers.....H. W. Barre
Influence of time of picking on keeping quality.....G. C. Starcher
Varieties.....G. C. Starcher
Certification.....J. A. Elliott
Transportation and storage.....R. H. Hill

February 25. General discussions

Tomato wilt and resistant varieties.....J. A. McClintock, C. W. Edgerton
Corn root and ear rots.....H. R. Rosen, S. H. Essary
Truck crop diseases.....C. D. Sherbakoff, W. C. Herron
Mosaic diseases, with special reference to a sweet potato mosaic, H. R. Rosen

After the program, the following officers were elected for the ensuing year.

President, S. H. Essary, Tennessee Experiment Station.

Vice president, J. A. Elliott, Arkansas Experiment Station.

Secretary, J. A. McClintock Georgia Experiment Station.

Member of the Council of the American Phytopathological Society for 1921, H. R. Rosen, Arkansas Experiment Station.

J. A. ELLIOTT,
Secretary.

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